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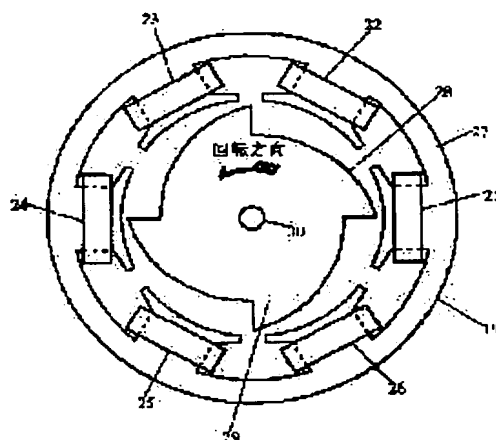
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(54) ELECTRICAL MACHINE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance the efficiency of an electrical machine which operates as a motor or a generator.
SOLUTION: A highly efficient electrical machine can be realized by employing a structure such as electrical angle in a range, where the inductance increases when a second object 28 is moved in one direction is different from the electrical angle in a range, where the inductance is decreased, thereby widening the range where the reluctance torque can be utilized effectively.



19 第1の物体
21、22、23、24、25、26 巻線
27、29 鉄心
28 第2の物体
30 軸

LEGAL STATUS

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CLAIMS

[Claim(s)]

[Claim 1] It is the electric machine with which the electrical angle of the range which said inductance increases when an inductance changes periodically according to change of the relative position of said 2nd body [as opposed to / consist of the 1st body which has a coil, and the 2nd body prepared movable to said 1st body, and / said 1st body in said coil] and said 2nd body is moved to an one direction differs from the electrical angle of the range where said inductance decreases.

[Claim 2] It is the electric machine according to claim 1 from which the 2nd body has an iron core and the distance of the front face of said iron core and said 1st body changes according to change of the relative position of said 1st body and said 2nd body.

[Claim 3] The 2nd body is an electric machine according to claim 1 or 2 from which the magnetic flux of said permanent magnet which has a permanent magnet and is interlinked to said coil according to change of the relative position of said 2nd body to the 1st body changes.

[Claim 4] It is the electric machine according to claim 3 from which the 2nd body consists of permanent magnets prepared in the front face of an iron core and said iron core, and the distance of the front face of said iron core and said 1st body changes according to change of the relative position of said 1st body and said 2nd body.

[Claim 5] The electrical angle from the location where the absolute value of the function which differentiated said inductance in the increment range of the inductance of a coil and the range of the direction whose electrical angle of the reduction range is size serves as a peak to the location used as the peak of the absolute value of change of the magnetic flux of the permanent magnet interlinked to said nearby coil is an electric machine according to claim 3 or 4 which is smallness from 45 degrees.

[Claim 6] The electric machine which supplies power to a mechanical load when it has a power source linked to a coil in addition to a configuration given in any 1 term of claims 1-5 and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as size from the electrical angle of the range where an inductance decreases.

[Claim 7] The electric machine which supplies power to said electrical circuit when it has an electrical circuit linked to a coil in addition to a configuration given in any 1 term of claims 1-5 and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as smallness from the electrical angle of the range where an inductance decreases.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention performs rotation etc., and it relates to the electric machine used as a generator in order to be used as a motor or to obtain power outdoors etc. in a home, works, an office, etc.

[0002]

[Description of the Prior Art] The block diagram of this kind in a Prior art of electric machine is shown in drawing 11.

[0003] In drawing 11, the 1st body 1 coils and constitutes coils 2, 3, 4, 5, 6, and 7 in the iron core 8, and the 2nd body 9 is formed free [rotation] as the 1st body 1 and same axle.

[0004] The 2nd body 9 is constituted by the permanent magnets 11, 12, 13, and 14 made from rare earth prepared in the form embedded to the interior of an iron core 10 and an iron core 10, and the output shaft 15 is formed in the core.

[0005] In addition, the outside serves as N pole, as for permanent magnets 13 and 14, the outside serves as the south pole and, as for permanent magnets 11 and 12, N pole and the south pole serve as a rotator of four poles where a total of four every two poles exist by 360 degrees, i.e., a round, on the machine square, respectively.

[0006] Drawing 12 shows the connection of the coils 2, 3, 4, 5, 6, and 7 of the conventional electric machine wound around the three phase circuit.

[0007] That is, U phase connects and constitutes coils 2 and 5 in a serial, V phase connects and constitutes coils 3 and 6 in a serial, and W phase has become what connected and constituted coils 4 and 7 in the serial.

[0008] Moreover, the black dot given to one side of each coil shows the polarity of each coil, and when a current is supplied from the terminal of the direction with the black dot of each coil, the south pole has occurred in the side which faced the inside 9 of each coil, i.e., the 2nd body.

[0009] Moreover, N point is the neutral point, and the electrical potential difference of each phase has the difference of the electrical angle of every 120 degrees mutually, when it sees on the basis of N point.

[0010] A power source 16 consists of AC power supply 17 and the inverter circuits 18 of 100V60Hz, and the inverter circuit 18 supplies the current of the sine wave which has the predetermined amplitude from U, V, and W terminal according to the relative position of the 1st body 1 and the 2nd body 9 to each coil.

[0011] While this electric machine rotates one time mechanically from it being the configuration of four poles, it rotates two times electrically and an electrical angle becomes twice a machine angle.

[0012] In the above configuration, actuation of the electric machine in a Prior art is explained.

[0013] Drawing 13 is the wave form chart of the conventional electric machine of operation.

[0014] The magnetic flux ϕ which interlinks (a) to the coils 2 and 5 of U phase in drawing 13, and the value which differentiated it by the electrical angle θ , That to which (b) differentiated the inductance value with the inductance value of the U phase windings 2 and 5, and (c) differentiated it by the electrical angle θ , The current value of U phase to which (**) is supplied from a power source 16, the BIL torque which generates (**) by the interaction of permanent magnets 11, 12, 13, and 14 and a current, and a (mosquito) show the reluctance torque generated by the interaction of an inductance value change and a current.

[0015] The (mosquito) shows each axis of abscissa according to the electrical angle θ from (**), and the core of the coils 2 and 5 of U phase is considering as the location which lapped with the core of permanent magnets 11 and 12 as a point of $\theta = 0$.

[0016] If it is the electrical angle rate ω when an electric machine rotates with constant speed, since θ will be set to ωt proportional to time amount t , the graph of a (mosquito) can be seen from (**) as

a wave form chart which made the axis of abscissa time amount t .

[0017] The broken line which magnetic flux ϕ became max at $\theta = 0, 180$ degrees as shown by the continuous line of (a), and became zero at the point of $90, 270$ degrees, and differentiated it by θ is that to which the phase progressed about 90 degrees to ϕ , and supposing ϕ is a sine wave, the wave of the broken line which is the differential will also serve as a sine wave.

[0018] The condition of being called the reverse salient pole property that become what an inductance value serves as min and serves as max in $90, 270$ degrees, generally embed, a direct-axis inductance serves as min with a magnetic electric machine under the effect of the permanent magnets 11, 12, 13, and 14 embedded in the location of $\theta = 0, 180$ degrees in the iron core 10, and an axis-of-abscissa inductance serves as max about the inductance shown in (b) is shown.

[0019] (c) differentiates (b) by θ , and although the differentiated function will also become sine wave-like supposing the method of change of an inductance is a sine wave-like, the period drops to $1/2$ compared with the wave shown in (a).

[0020] Therefore, the increment range A of the inductance L of a coil and the reduction range B are all 90 degrees in an electrical angle, and the electrical angle from the location C where the absolute value of the function which differentiated the inductance in the increment period A serves as a peak to the location D used as the peak of the absolute value of change of the magnetic flux of the permanent magnet interlinked to a nearby coil is 45 degrees.

[0021] Moreover, the electrical angle from the location E where the absolute value of the function which differentiated the inductance in the reduction period B serves as a peak to the location D used as the peak of the absolute value of change of the magnetic flux of the permanent magnet interlinked to a nearby coil is 45 degrees too.

[0022] Although supplied from the power source 16, the wave of the current I of U phase shown in (d) is made into the leading phase of 30 electrical angles to $d\phi/d\theta$ wave form shown in the broken line of (a) in order to utilize the reluctance torque mentioned later as effectively as possible.

[0023] Although the BIL torque shown in (e) shows only what is generated in permanent magnets 11, 12, 13, and 14 and the U phase windings 2 and 5, it becomes a thing proportional to the product of the instantaneous value of the current I shown in $d\phi/d\theta$ shown in the broken line of (a), and (d).

[0024] The reluctance torque shown in a (mosquito) becomes a thing proportional to the product of a value which squared the current I shown in change $dL/d\theta$ of the inductance shown in (c), and (c).

[0025] Supposing the wave of Current I is as in phase as the wave of the broken line of (a), a product with the wave of (c) occurs in the symmetry over positive/negative, and although the time average of zero, i.e., reluctance torque, will also become zero and the average will become only what only generates a torque ripple, here By supplying the current by the leading phase of 30 degrees, the average of reluctance torque should become forward and shall have been acquired as effective power.

[0026] What added the wave of (**) and a (mosquito) is the torque which can be taken out from an output shaft 15, and when operating with constant speed, a power output also serves as the same wave as torque.

[0027] In fact, since it is a three phase circuit, the torque of V phase of a phase and W phase which shifted 120 electrical angles at a time mutually is added further, and turns into total torque (output).

[0028] By repeating the above actuation, the electric machine of a Prior art changes into power the power applied to each coil from a power source 16, and it is operating as the motor which carries out the operation supplied to the mechanical load connected to an output shaft 15, or equipment called a motor.

[0029]
[Problem(s) to be Solved by the Invention] In the above Prior arts, since reluctance torque can also be made to act effectively in addition to BIL torque, operation efficient as a motor is enabled.

[0030] However, although each of (**)s of drawing 13, and (mosquito) the shown BIL torque and reluctance torque is forward values as the average, it serves as negative in the period of the slash of (**) and a (mosquito) about instantaneous value.

[0031] That is, about the period, the sense of generating of torque is contrary to the direction of rotational, and it is operating as a brake.

[0032] About reluctance torque, although it is also possible to prevent the brake by reluctance torque by making into zero the current in the period when the value of $dL/d\theta$ serves as negative, since it becomes impossible to also acquire the BIL torque in the period concerned in that case, induced electromotive force (it is proportional to the product of $d\phi/d\theta$ and a rate) of **** cannot be connected with torque, and output sufficient as a result cannot be secured.

[0033] Therefore, in the electric machine of a Prior art, there was little effectiveness by concomitant use of

reluctance torque, and improvement in effectiveness also had the 1st technical problem were not so large. [0034] Moreover, although this kind of electric machine is used as a generator also in the conversion to power from power, it had the 2nd technical problem of a flume which decline in effectiveness generates similarly also in such a case.

[0035] The forward period and the negative period were by one half, and the $dL/d\theta$ wave form shown in (c) especially about reluctance torque was what can all use only 50% of period of the whole period by the current supply source of only a negative period serving as conditions in making it operate as a forward period and a generator, when making it operate as a motor, in order to use reluctance torque effectively.

[0036] This invention realizes an electric machine with the high effectiveness which changes still better into torque the current which should differ the period used as negative [for solving said the 1st technical problem and 2nd technical problem / the period when it is at and change of reluctance torque, i.e., a differential value, serves as forward especially and negative], and is supplied to a coil, or can change torque into power effectively.

[0037]

[Means for Solving the Problem] In order to solve this technical problem, this invention consists of the 1st body which has a coil, and the 2nd body prepared movable to said 1st body. According to change of the relative position of said 2nd body [as opposed to said 1st body in said coil], an inductance changes periodically. When said 2nd body is moved to an one direction, by considering as the configuration from which the electrical angle of the range which said inductance increases, and the electrical angle of the range where said inductance decreases differ, the torque to generate improves the degree used as negative, and improves the further effectiveness.

[0038]

[Embodiment of the Invention] Invention of this invention according to claim 1 consists of the 1st body which has a coil, and the 2nd body prepared movable to said 1st body. According to change of the relative position of said 2nd body [as opposed to said 1st body in said coil], an inductance changes periodically. By having considered as the configuration from which the electrical angle of the range which said inductance increases when said 2nd body is moved to an one direction, and the electrical angle of the range where said inductance decreases differ By choosing a hand of cut according to the application of a motor and a generator, the size relation between the increment period of an inductance wave and a reduction period is changed, and it also sets for which application. A coil current in the range of a large electrical angle with a sink Conversion of power and power can be effectively performed through reluctance torque, and an electric machine with high effectiveness is offered.

[0039] In invention according to claim 2, the 2nd body of an electric machine according to claim 1 has an iron core. Moreover, the distance of the front face of said iron core, and said 1st body By having considered as the configuration which changes according to change of the relative position of said 1st body and said 2nd body By choosing a hand of cut according to the application of a motor and a generator too The size relation between the increment period of an inductance wave and a reduction period is changed, and it also sets for which application. A coil current in the range of a large electrical angle with a sink Especially, performing conversion of power and power effectively through reluctance torque can be realized with an easy configuration, and it offers an electric machine with high effectiveness.

[0040] Moreover, invention according to claim 3 has a permanent magnet on the 2nd body of the electric machine of claim 1 or claim 2 given in any 1 term. By having considered as the configuration from which the magnetic flux of said permanent magnet interlinked to said coil changes according to change of the relative position of said 2nd body to the 1st body By the interaction with the magnetic flux which the size relation between the increment period of an inductance wave and a reduction period is changed, and a permanent magnet has by choosing a hand of cut according to the application of a motor and a generator Also in which application, conversion of power and power can be effectively performed for a coil current in the range of a large electrical angle through reluctance torque and BIL torque with a sink, and it is provided with an electric machine with high effectiveness.

[0041] Invention according to claim 4 consists of permanent magnets in which the 2nd body of an electric machine according to claim 3 was prepared on the front face of an iron core and said iron core. Moreover, the distance of the front face of said iron core, and said 1st body By having considered as the configuration which changes according to change of the relative position of said 1st body and said 2nd body By choosing a hand of cut according to the application of a motor and a generator too By the interaction with the magnetic flux which the size relation between the increment period of an inductance wave and a reduction period is changed, and a permanent magnet has Performing conversion of power and power for a coil

current in the range of a large electrical angle effectively through reluctance torque and BIL torque with a sink also in which application can be realized with a comparatively easy configuration, and it offers an electric machine with high effectiveness.

[0042] Moreover, the location where the absolute value of the function with which invention according to claim 5 differentiated said inductance in the increment range of the inductance of the coil of an electric machine claim 3 or given in claim 4 any 1 term and the range of the direction whose electrical angle of the reduction range is size serves as a peak, The electrical angle to the location used as the peak of the absolute value of change of the magnetic flux of the permanent magnet interlinked to said coil By choosing a hand of cut by having considered as the configuration which is smallness from 45 degrees according to the application of a motor and a generator too By the interaction with the magnetic flux which the size relation between the increment period of an inductance wave and a reduction period is changed, and a permanent magnet has Also in which application a coil current in the range of a large electrical angle with a sink Conversion of power and power can be effectively performed through reluctance torque and BIL torque, and since large reluctance torque can also be taken with the phase from which especially BIL torque serves as max, an electric machine with high effectiveness is offered.

[0043] Moreover, invention according to claim 6 is added to the configuration of claim 1 to claim 5 given in any 1 term. When it has a power source linked to a coil and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as size from the electrical angle of the range where an inductance decreases By having considered as the configuration which supplies power to a mechanical load, an electric machine with effectiveness high especially as a motor is realized.

[0044] Moreover, invention according to claim 7 is added to the configuration of claim 1 to claim 5 given in any 1 term. When it has an electrical circuit linked to a coil and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as smallness from the electrical angle of the range where an inductance decreases By having considered as the configuration which supplies power to said electrical circuit, an electric machine with effectiveness high especially as a generator is realized.

[0045]

[Example] Next, the example of this invention is explained.

[0046] (Example 1) Drawing 1 is the block diagram of the electric machine in the example 1 which used claim 1 of this invention, claim 2, and claim 6.

[0047] In drawing 1, the 1st body 19 coils and constitutes coils 20, 21, 22, 23, 24, 25, and 26 in the iron core 27, and the 2nd body 28 is formed free [rotation] as the 1st body 19 and same axle.

[0048] The 2nd body 28 has the iron core 29, and the shaft 30 is formed in the core.

[0049] Here, the iron core 29 serves as a rotator of four poles where four parts from which the distance between the 1st body 19, i.e., an opening, serves as smallness exist.

[0050] Drawing 2 shows the connection of the coils 21, 22, 23, 24, 25, and 26 coiled around the three phase circuit.

[0051] That is, U phase connects and constitutes coils 21 and 24 in a serial, V phase connects and constitutes coils 22 and 25 in a serial, and W phase has become what connected and constituted coils 23 and 26 in the serial.

[0052] Moreover, N point is the neutral point, and the electrical potential difference of each phase has the difference of the electrical angle of every 120 degrees mutually, when it sees on the basis of N point.

[0053] The power source 31 consisted of DC power supply 32 and the transistors 33, 34, and 35 of 100V, and has carried out sequential ON of the transistors 33, 34, and 35 by the drive circuit 36 according to the relative position of the 1st body 19 and the 2nd body 28.

[0054] Actuation of the electric machine of an example 1 is explained in the above configuration.

[0055] Drawing 3 is the wave form chart of the electric machine of an example 1 of operation.

[0056] In drawing 3, the current I of U phase and (d) to which $dL/d\theta$ which (a) differentiated the inductance value with the inductance value L of the coils 21 and 24 of U phase, and differentiated (b) by the electrical angle θ , and (c) are supplied from a power source 16 show the reluctance torque generated by the interaction of inductance value-change $dL/d\theta$ and Current I.

[0057] In addition, although an axis of abscissa θ is an electrical angle, the direction which the 2nd body 28 rotates counterclockwise as shown in drawing 1, i.e., the direction operated as a motor, is made forward.

[0058] In the example 1, the configuration of an iron core 29 is considered as the configuration which changes with θ (electrical angle of an angle of rotation) in the distance of the front face of an iron core

29, and the 1st body 19, i.e., the magnitude of an opening, as shown in drawing 1, an opening serves as smallness gradually with the increment in theta further, and the inductance is increasing gradually.

[0059] And it sets to theta beyond the location where the opening became min and the inductance became max. From having the composition that a large next door and an inductance decrease and an opening serves as the minimum value suddenly The electrical angle A of the range ($dL/d\theta > 0$) which it becomes the wave of the inductance L of the shape of a saw tooth wave as shown in (**), and the function differentiated by theta becomes what is shown in (**), namely, L increases Compared with the electrical angle B of the range ($dL/d\theta < 0$) where L decreases, it is size overwhelmingly.

[0060] The value of reluctance torque becomes a thing proportional to the value which multiplied the square of the instantaneous value of the current I shown in (c) by the value of $dL/d\theta$ shown in (b), and serves as the wave as reluctance torque also with the same wave of the output which can be taken out as power.

[0061] Here, in the period of B, the wave of the current I shown in (c) is made into zero, when the transistor 33 is turned off by the drive circuit 36.

[0062] Therefore, about the period of B, although only the period of A occurs and the reluctance torque shown in (d) becomes positive sense, i.e., the sense committed as a motor, because whose current value I is zero, reluctance torque also becomes with zero.

[0063] Although it will become what will be in the condition that it was not concerned with the positive/negative of Current I, but negative reluctance torque occurred, and the brake worked if Current I flows in the period of B, in the example 1, about brake actuation, it does not happen and, therefore, a current always contributes to the dynamogenesis effectively.

[0064] Moreover, even if the period which can generate power is long and therefore supplies a current by the big electrical angle from a ***** more overwhelmingly [the period of A] than the period of B The use effectiveness of a coil being high and reducing current rating required for transistors 33, 34, and 35, since it is not necessary to centralize a current for a short period of time, and to generate reluctance torque, without the brake working The copper loss generated in case fixed power is obtained can also be stopped few.

[0065] Moreover, since a torque ripple can also be pressed down comparatively small, it acts advantageously also from the noise or the field of vibration.

[0066] (Example 2) Drawing 4 is the block diagram of the 2nd body 37 of the electric machine in the example 2 which used claim 3 of this invention, claim 4, and claim 6.

[0067] In the example 2, it should consider as the same configuration as the 1st body 19 of drawing 1, and the configurations of the 2nd body 37 should differ.

[0068] The 2nd body 37 has formed permanent magnets 38, 39, 40, and 41 in the front face of the iron core 29 equivalent to an example 1, and about permanent magnets 38 and 39, outside, it is arranged so that the south pole may be outside suitable for N pole in permanent magnets 40 and 41 again.

[0069] Moreover, thickness all makes permanent magnets 38, 39, 40, and 41 the peculiar configuration which changes gradually so that an outside may serve as a circle in the condition of having stuck on the front face of an iron core 29.

[0070] Drawing 5 is the wave form chart of an example 2 of operation.

[0071] The magnetic flux phi which interlinks (a) to the coils 2 and 5 of U phase in drawing 5, and the value which differentiated it by the electrical angle theta, That to which (b) differentiated the inductance value with the inductance value of the U phase windings 21 and 24, and (c) differentiated it by the electrical angle theta, The BIL torque which generates (**) with the current value of U phase, and generates (**) by the interaction of permanent magnets 38, 39, 40, and 41 and Current I, and a (mosquito) show the reluctance torque generated by the interaction of an inductance value change and a current.

[0072] In an example 2, the wave of differential $d\phi/d\theta$ shown with the magnetic flux phi shown as the continuous line of (a) and a broken line becomes the almost same thing as the Prior art shown in drawing 13.

[0073] About the inductance shown in (b), it becomes being the same as that of an example 1 because of the configuration of an iron core 29.

[0074] Also about (**), (**) is differentiated by theta, it becomes that this is the same as that of an example 1, and the period A which an inductance L increases ($dL/d\theta > 0$) is long overwhelmingly as compared with the period B when an inductance L decreases ($dL/d\theta < 0$).

[0075] In an example 2, the BIL torque shown in (**) and the reluctance torque shown in a (mosquito) are acquired by making into a wave like (**) the current I supplied from a power source.

[0076] Namely, by making into zero the current I which flows to U phase at the period of B Have prevented

generating of the reluctance torque of hard flow and at the period of A according to generating of the reluctance torque of the forward direction, and BIL torque by Current I Since it becomes the thing to which actuation of producing torque well can be made to perform and a part for the ripple of the torque to generate can also be stopped, it has the property excellent also in the field of suppressing the noise and vibration.

[0077] (Example 3) Drawing 6 is the block diagram of the 2nd body 42 of the electric machine in the example 3 which used claim 3 of this invention, claim 4, claim 5, and claim 6.

[0078] Also in the example 3, it should consider as the same configuration as the 1st body 19 of drawing 1 , and the configurations of the 2nd body 42 should differ.

[0079] The 2nd body 42 has formed permanent magnets 44, 45, 46, and 47 in the front face of an iron core 43, and about permanent magnets 44 and 45, outside, it is arranged so that the south pole may be outside suitable for N pole in permanent magnets 46 and 47 again.

[0080] In the example 3, the configurations of an iron core 43 and permanent magnets 44, 45, 46, and 47 differ to the example 2, and the methods of change of the distance of the iron core 43 and the 1st body 19 to theta differ.

[0081] Drawing 7 is the wave form chart of an example 3 of operation.

[0082] In drawing 7 , it is the same as an example 2 about value $d\phi/d\theta$ which differentiated the magnetic flux ϕ shown in the continuous line of (a), and it by the electrical angle theta.

[0083] However, about the inductance value of the U phase windings 21 and 24 of (b), the wave of the increment part of an inductance becomes what increases quickly near 90 degrees and the 270 degrees for the configuration of an iron core 43, and the peak exists near 90 degrees and the 270 degrees also about what differentiated the inductance value of (c) by the electrical angle theta.

[0084] The current I of U phase shown in (d) also in an example 3 is the same as an example 2, the BIL torque which shows it to (e) since the wave of $d\phi/d\theta$ shown with the broken line of (a) is near becomes being the same as that of an example 3, and a current is efficiently changed into torque.

[0085] Moreover, the increment range A of the inductance L of a coil and the range of the direction whose electrical angle of the reduction range B is size, Namely, nearby [the location C where the absolute value of function $dL/d\theta$ which differentiated the inductance in the increment range A serves as a peak to], The electrical angle to the location D used as the peak of the absolute value of change $d\phi/d\theta$ of the magnetic flux of the permanent magnet interlinked to a coil has composition of claim 5 which is about 0 and was made more extremely than 45 degrees into smallness in the example 3.

[0086] Since it is almost more nearly equal still to the wave of Current I also about the wave of $dL/d\theta$ in moreover and an example 3, especially the reluctance torque shown in a (mosquito) is near the peak of $dL/d\theta$, it divides from Current I serving as a peak, a big thing is obtained, and reluctance torque is acquired efficiently.

[0087] Therefore, Current I becomes what is changed into BIL torque and reluctance torque very well, and an electric machine with very high effectiveness can be realized as a motor.

[0088] The electric machine of an example 1 to the example 3 is effective in the motor especially used in the hand of cut of an one direction. The fan motors a ventilating fan, a fan, the object for cleaners, for cooling, etc., and the pump which is electric from an electric hot water heater, and pumps out a molten bath, It can use for what is used as various sources of power, such as a ship, an automobile, and an electric car, effectively as the motor for moving compressors, such as a bath water pump used for a washing machine etc., a pump used for an automatic dishwasher, a refrigerator, and an air-conditioner, and an object for traffic.

[0089] (Example 4) Drawing 8 is the circuit diagram of the electric machine in the example 4 which used claim 3 of this invention, claim 4, and claim 7.

[0090] In an example 4, the electrical circuit 48 is further connected using a configuration equivalent to the 1st body 19 of an example 1, and the 2nd body 37 of an example 2.

[0091] An electrical circuit 48 forms the switching elements 49, 50, 51, 52, 53, and 54 which connected and constituted a transistor and diode in juxtaposition, and the base of all switching elements is connected to the drive circuit 55, the drive circuit 55 controls turning on and off of each switching element according to the relative position of the 2nd body 37 to the 1st body 19, and it supplies a predetermined current wave form to each coil.

[0092] Furthermore, it connected with juxtaposition and a capacitor 56 and load resistance 57 are formed.

[0093] Drawing 9 is the wave form chart of an example 4 of operation.

[0094] In the example 4, the direction of rotational carries out to reverse, i.e., a clockwise rotation, in an example 2, and the electrical angle theta of an axis of abscissa makes the clockwise rotation forward.

[0095] Also in drawing 9, ϕ of a continuous line and $d\phi/d\theta$ of a broken line become equivalent to drawing 5 about the wave of (a).

[0096] However, about the inductance value shown in (b), the direction of rotational serves as a reason with an opposite example 2, and a wave turned over, and the increment period A will become short more overwhelmingly than the reduction period B.

[0097] It becomes a thing as what differentiated the inductance value shown in (c) by the electrical angle θ is shown.

[0098] Although (d) is the wave of the current I of U phase, since it is made to operate as a generator, in the example 4, $I < 0$ and $d\phi/d\theta$ set to $I > 0$ at a forward period at a negative period, by this, the BIL torque shown in (e) serves as a negative value, and $d\phi/d\theta$ shows the condition of performing the operation which this absorbs power and is changed into power.

[0099] Moreover, also about the reluctance torque shown in a (mosquito), $dL/d\theta$ becomes a negative value from Current I flowing at the negative period, and this also helps generator actuation.

[0100] In the case of an example 4, the period to which $dL/d\theta$ can carry out actuation as a generator by reluctance torque from a ***** more overwhelmingly than a period forward in a negative period becomes more than one half during the whole term with a **** and the thing which an electric machine can operate as a generator effectively also in respect of reluctance torque, also performing conversion with BIL torque effectively therefore.

[0101] In addition, in an example 4, although a coil is made into a three phase circuit and the electrical circuit 48 is considered as the configuration of six stones, it is not necessarily required to make it a three phase circuit, and using the thing of a configuration of being called the inverter circuit of six stones never calls it the need.

[0102] (Example 5) Drawing 10 is the block diagram of the electric machine which used each claim made into different structure in an example 1 - an example 4 in the configuration of the 1st body of this invention, and the 2nd body.

[0103] By (a) arranging the 2nd body 58 on the outside of the 1st body 57, when it is stood still and the 2nd body rotates, the 1st body 57 supplies rotational power to a load, and has composition called the so-called outer rotor.

[0104] (b) consists of the 1st disc-like body 59 and the 2nd disc-like body 60 too, and it is in the stationary condition, and when the 2nd body 60 rotates, the 1st body 59 is what supplies rotational power to a load, and has composition called the axial gap motor or field confrontation which has an opening in shaft orientations.

[0105] (c) is a configuration called the linear motor which supplies power to a load when the 1st body 61 and 2nd body 62 perform rectilinear motion mutually. The 1st body 61 It has the coils 69, 70, 71, 72, 73, and 74 formed in the iron core 68. The magnetic pole which the 2nd body 62 has the composition of having stuck permanent magnets 63, 64, 65, and 66 on the near front face facing the 1st body 61 of the iron core 62 of a saw form, and is produced on the 1st body 61 About N pole and permanent magnets 64 and 66, it considers [permanent magnets / 63 and 65] as the south pole. 100mm is an electric machine equivalent to 360 electrical angles by having constituted too three coils of the 1st body 61 which prepares a part for one of the group of N pole and the south pole in die length of 100mm, and constitutes a three phase from 100mm.

[0106] Even if it carries out such a rectilinear motion, when the 1st body 61 and 2nd body 62 exercise relatively, it becomes periodic flux reversal and an electrical potential difference, and the thing to which change of a current takes place, and becomes the criteria of each claim of this invention.

[0107] In addition, although each stands it still and the 2nd body 58, 60, and 62 has become the side which rotates or moves, the 1st body 57, 59, and 61 shown in drawing 10 (a) - (c) If it is free which is made into a quiescence side also about this and relative motion of the 1st body and the 2nd body is performed in short If the relative velocity or relative rotational speed by it arises, this is inputted or it is outputted, since what multiplied this by the force or torque serves as machine power, and conversion of machine power and electric power is made Also in which configuration, the effectiveness of this invention can be acquired equally.

[0108] Moreover, in each example, although the thing which is using the configuration of claim 2 and claim 4 that the configuration of an iron core distinguishes between the electrical angle of the range which an inductance increases when distance with the 1st body shall change, and the range which decreases in number is shown, neither claim 1 nor claim 3 may be limited to especially such a configuration, and the configuration of other iron cores etc. is sufficient as it.

[0109] Moreover, although the electric machine used as a motor is shown and the example 4 shows the

electric machine used as a generator, even if an example 1, an example 2, and an example 3 do not have limitation in whether it uses especially as a motor, or it uses as a generator and are the same configuration, they serve as an efficient motor according to the direction of rotational, and serve as an efficient generator by use by rotation of hard flow.

[0110] It follows, limitation of the application of a motor and a generator is not made at the time of sale, but all the things that are the configurations of claim 1 to claim 5 are contained in a claim also about an electric machine with which an application is chosen for the sake of a purchaser's convenience, and the electric machine used for a different application from the application display at the time of a purchaser being purchase.

[0111]

[Effect of the Invention] Especially claim 1 consists of the 1st body which has a coil, and the 2nd body prepared movable to said 1st body as mentioned above. According to change of the relative position of said 2nd body [as opposed to said 1st body in said coil], an inductance changes periodically. When said 2nd body is moved to an one direction, an electric machine with high effectiveness is offered by having considered as the configuration from which the electrical angle of the range which said inductance increases, and the electrical angle of the range where said inductance decreases differ.

[0112] Moreover, in invention according to claim 2, especially the 2nd body of an electric machine according to claim 1 has an iron core, and the distance of the front face of said iron core and said 1st body offers an electric machine with high effectiveness with an easy configuration by having considered as the configuration which changes according to change of the relative position of said 1st body and said 2nd body.

[0113] Moreover, especially invention according to claim 3 has a permanent magnet on the 2nd body of the electric machine of claim 1 or claim 2 given in any 1 term, and offers an electric machine with high effectiveness by having considered as the configuration from which the magnetic flux of said permanent magnet interlinked to said coil changes according to change of the relative position of said 2nd body to the 1st body.

[0114] Moreover, especially invention according to claim 4 consists of permanent magnets in which the 2nd body of an electric machine according to claim 3 was prepared on the front face of an iron core and said iron core, and the distance of the front face of said iron core and said 1st body offers an electric machine with high effectiveness with a comparatively easy configuration by having considered as the configuration which changes according to change of the relative position of said 1st body and said 2nd body.

[0115] Moreover, nearby [the location where the absolute value of the function with which especially invention according to claim 5 differentiated said inductance in the increment range of the inductance of the coil of an electric machine claim 3 or given in claim 4 any 1 term and the range of the direction whose electrical angle of the reduction range is size serves as a peak to], The electrical angle to the location used as the peak of the absolute value of change of the magnetic flux of the permanent magnet interlinked to said coil offers an electric machine especially with high effectiveness by having considered as the configuration which is smallness from 45 degrees.

[0116] Moreover, especially invention according to claim 6 is added to the configuration of claim 1 to claim 5 given in any 1 term. When it has a power source linked to a coil and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as size from the electrical angle of the range where an inductance decreases By having considered as the configuration which supplies power to a mechanical load, an electric machine with effectiveness high especially as a motor is realized.

[0117] Moreover, especially invention according to claim 7 is added to the configuration of claim 1 to claim 5 given in any 1 term. When it has an electrical circuit linked to a coil and the 1st body and 2nd body motion relatively in the direction in which the electrical angle of the range which the inductance of said coil increases serves as smallness from the electrical angle of the range where an inductance decreases By having considered as the configuration which supplies power to said electrical circuit, an electric machine with effectiveness high especially as a generator is realized.

[Translation done.]

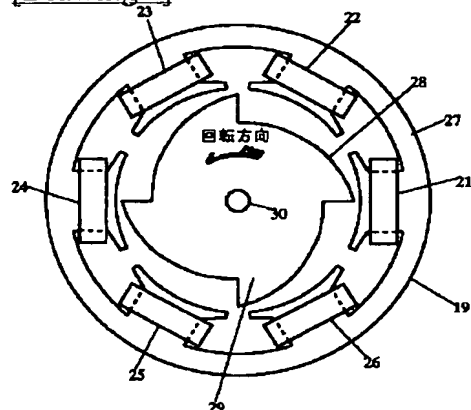
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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

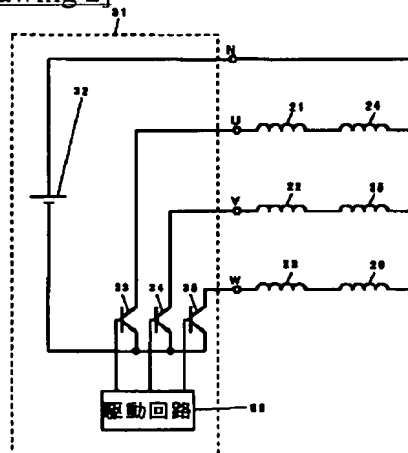
DRAWINGS

[Drawing 1]



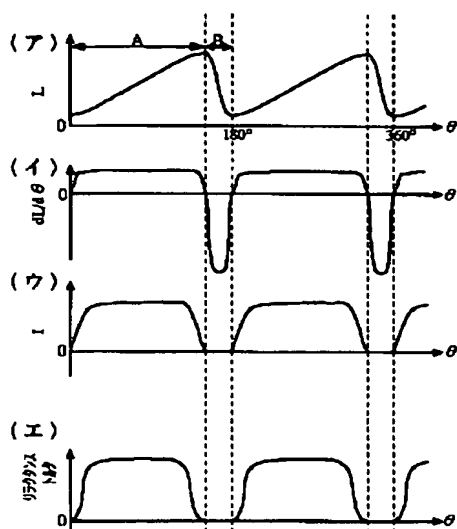
- 19 第1の物体
 21、22、23、24、25、26 巻線
 27、29 鉄心
 28 第2の物体
 30 軸

[Drawing 2]

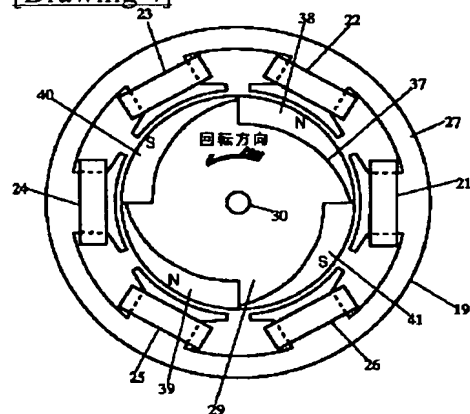


- 21、22、23、24、25、26 巻線
 31 電源
 32 直流電源
 33、34、35 トランジスタ

[Drawing 3]



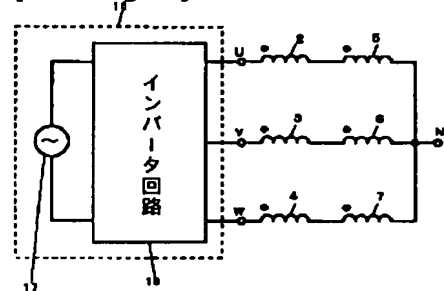
[Drawing 4]



37 第2の物体

38、39、40、41 永久磁石

[Drawing 12]

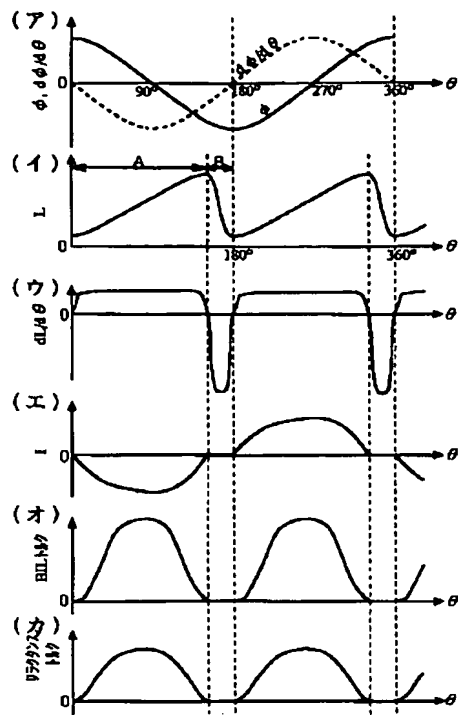


2、3、4、5、6、7 巻線

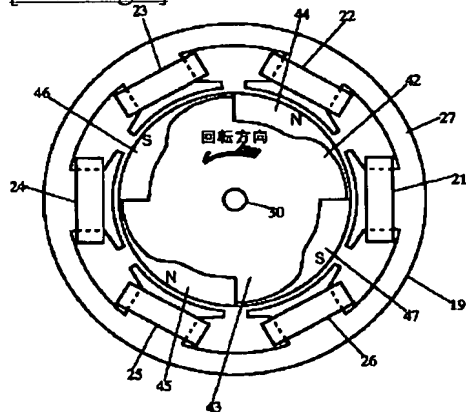
16 電源

17 交流電源

[Drawing 5]



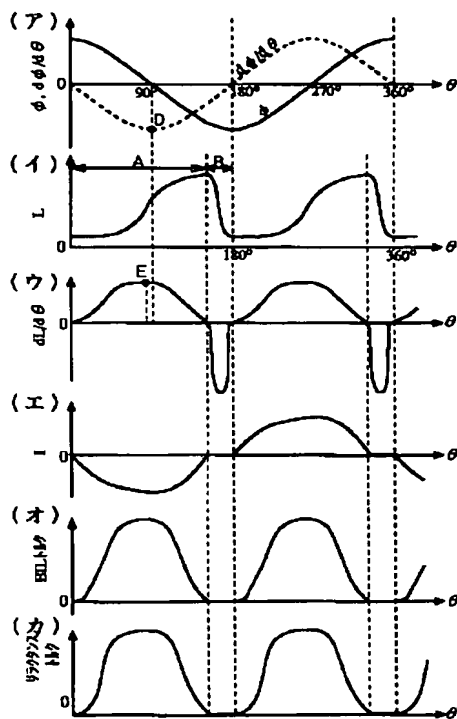
[Drawing 6]



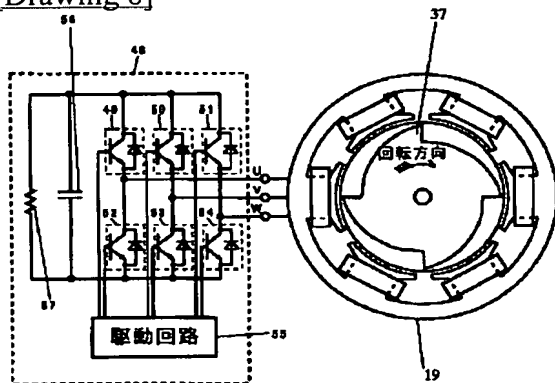
42 第2の物体

44、45、46、47 永久磁石

[Drawing 7]

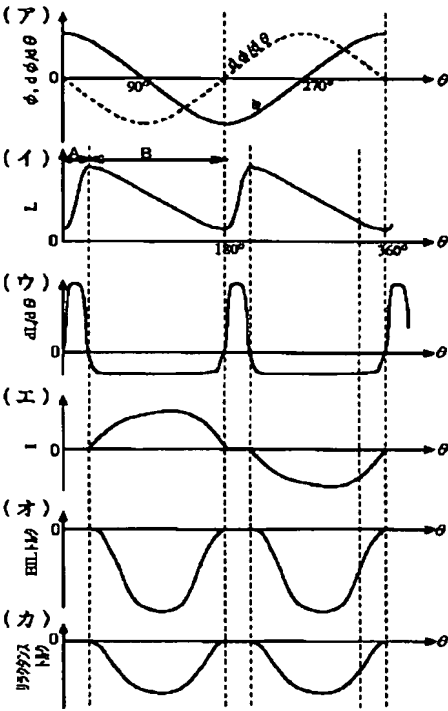


[Drawing 8]

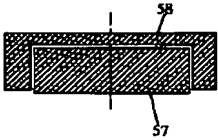


- 48 電気回路
 49、50、51、52、53、54 トランジスタ
 56 コンデンサ
 57 負荷抵抗

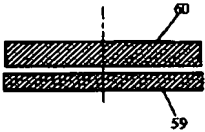
[Drawing 9]



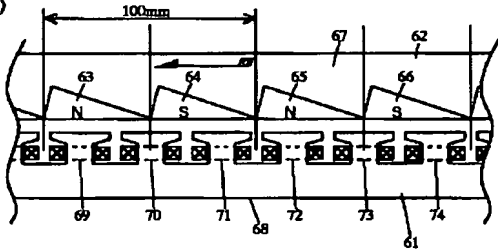
[Drawing 10]
(ア)



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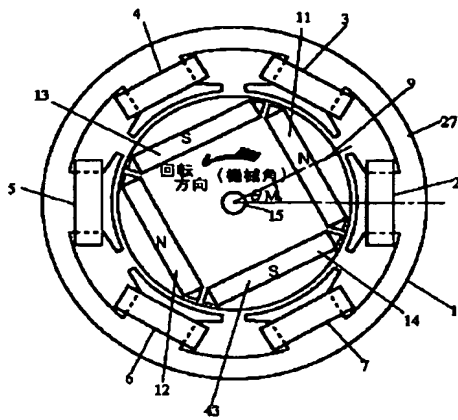


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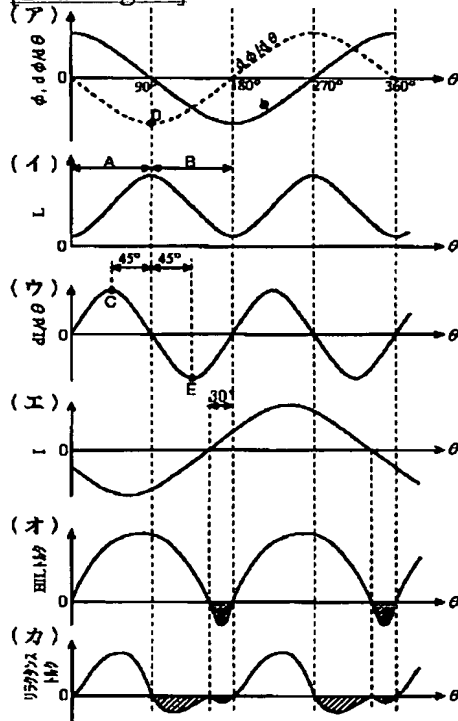
57、59、61 第1の物体
58、60、62 第2の物体
68 鉄心

[Drawing 11]



- 1 第1の物体
 2、3、4、5、6、7 巻線
 9 第2の物体
 11、12、13、14 永久磁石
 15 軸
 27、43 鉄心

[Drawing 13]



[Translation done.]